

WEED RISK ASSESSMENT FORM

Botanical name: Cotula coronopifolia L.

Common name: common brassbuttons

Assessors: Irina Lapina Matthew L. Carlson, Ph.D.
 Botanist, Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska 99501 tel: (907) 257-2710; fax (907) 257-2789
 Assistant Professor, Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, Alaska 99501 tel: (907) 257-2790; fax (907) 257-2789

Reviewers: Jeff Conn, Ph.D. Jeff Heys
 Weed Scientist, USDA Agricultural Research Service
 PO Box 757200 Fairbanks, Alaska 99775 tel: (907) 474-7652; fax (907) 474-6184
 Exotic Plant Management Program Coordinator, National Park Service, Alaska Region - Biological Resources Team, 240 W. 5th Ave, #114, Anchorage, AK 99501 tel: (907)644-3451, fax: 644-3809

Roseann Densmore, Ph.D. Julie Riley
 Research Ecologist, US Geological Survey, Alaska Biological Science Center, 1101 East Tudor Road Anchorage, AK 99503 tel: (907) 786-3916, fax (907) 786-3636
 Horticulture Agent, UAF Cooperative Extension Service
 2221 E. Northern Lights Blvd. #118 Anchorage, AK 99508-4143 tel: (907) 786-6306

Jamie M. Snyder
 UAF Cooperative Extension Service
 2221 E. Northern Lights Blvd. #118 Anchorage, AK 99508-4143 tel: (907) 786-6310 alt.tel: (907) 743-9448

Outcome score:

A. Climatic Comparison		
This species is present or may potentially establish in the following eco-geographic regions:		
1 South Coastal	Yes	
2 Interior-Boreal		No
3 Arctic-Alpine		No

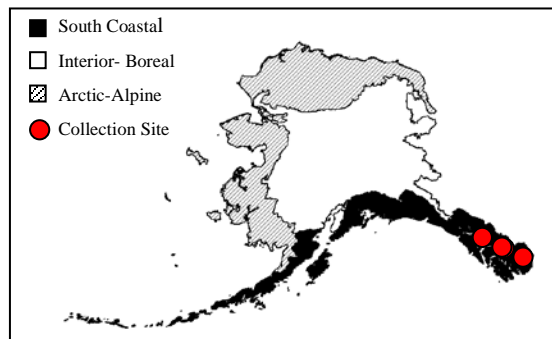
B. Invasiveness Ranking	Total (Total Answered*) Possible	Total
1 Ecological impact	40 (40)	14
2 Biological characteristic and dispersal ability	25 (23)	11
3 Ecological amplitude and distribution	25 (25)	9
4 Feasibility of control	10 (10)	7
Outcome score	100 (98) ^b	41 ^a
Relative maximum score†		0.42

* For questions answered "unknown" do not include point value for the question in parentheses for "Total Answered Points Possible."

† Calculated as ^{a/b}.

A. CLIMATIC COMPARISON:

1.1. Has this species ever been collected or documented in Alaska?	
Yes	Yes – continue to 1.2 No – continue to 2.1
1.2. Which eco-geographic region has it been collected or documented (see inset map)? <i>Proceed to Section B. Invasiveness Ranking.</i>	
Yes	South Coastal Interior-Boreal Arctic-Alpine



Documentation: *Cotula coronopifolia* has been documented in the South Coastal ecoregion of Alaska (Hultén 1968, Welsh 1974). It is known from Petersburg and Gambier Bay (M. Shephard – pers. com.). Sources of information:
 Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.
 Shephard, M., Vegetation Ecologist, USDA, Forest Service, Forest Health Protection, State and Private Forestry, 3301 C Street, Suite 202, Anchorage, Alaska 99503 Division. Tel: (907) 743-9454 - Pers. comm.
 Welsh, S.L. 1974. Anderson’s flora of Alaska and adjacent parts of Canada. Brigham University Press. 724 pp.

2.1. Is there a 40% or higher similarity (based on CLIMEX climate matching) between climates any where the species currently occurs and

- a. Juneau (South Coastal Region)?
 - Yes – record locations and similarity; proceed to Section B. Invasiveness Ranking
 - No
 - b. Fairbanks (Interior-Boreal)?
 - Yes – record locations and similarity; proceed to Section B. Invasiveness Ranking
 - No
 - c. Nome (Arctic-Alpine)?
 - Yes – record locations and similarity; proceed to Section B. Invasiveness Ranking
 - No
- If “No” is answered for all regions, reject species from consideration

Documentation: Using CLIMEX matching program, climatic similarity between Fairbanks, Nome and areas where the species is documented is relatively low. It is therefore unlikely to establish in the Arctic-Alpine or Interior-Boreal ecogeographic regions of Alaska. Climatic similarity between Anchorage and areas where the species is documented is relatively high, however. *Cotula coronopifolia* has been reported from Lærdal, Norway (Lid and Lid 1994), which has 61% climatic similarity with Anchorage, Alaska (CLIMEX 1999). However, *Cotula coronopifolia* germinates in late autumn and winter, causing high seedlings mortality due to winter frost (van der Toorn and ten Hove 1982). Thus establishment in the Interior-Boreal Region is unlikely.

Sources of information:
 CLIMEX for Windows, Version 1.1a. 1999. CISRO Publishing, Australia.
 Lid, J. and D.T. Lid. 1994. Flora of Norway. The Norske Samlaget, Oslo. Pp. 1014.
 van der Toorn, J. and H.J. ten Hove. 1982. On the ecology of *Cotula coronopifolia* L. and *Ranunculus scleratus* L. II. – Experiments on germination, seed longevity, and seedling survival. Acta Oecologica 3(17): 409-418.

B. INVASIVENESS RANKING

1. ECOLOGICAL IMPACT

1.1. Impact on Natural Ecosystem Processes

- A. No perceivable impact on ecosystem processes 0
- B. Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability) 3
- C. Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl) 7
- D. Major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology; hydrology; or affects fire frequency, altering community composition; species fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species) 10
- U. Unknown

Score 3

Documentation:

Identify ecosystem processes impacted:

In northwestern Europe common brassbuttons is a pioneer colonist of bare, wet soils (van der Toorn 1980, van der Toorn and ten Hove 1982); therefore, it can likely hinder natural colonization by native species in areas it is introduced.

Rational:

Sources of information:

van der Toorn, J. 1980. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. I. Geographic distribution, habitat, and field observation. Acta Botanica Neerlandica. 29(5/6): 385-396.

van der Toorn, J. and H.J. ten Hove. 1982. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. II. – Experiment on germination, seed longevity, and seedling survival. Acta Oecologica 3 (17): 409-418.

1.2. Impact on Natural Community Structure

- A. No perceived impact; establishes in an existing layer without influencing its structure 0
- B. Influences structure in one layer (e.g., changes the density of one layer) 3
- C. Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer) 7
- D. Major alteration of structure (e.g., covers canopy, eradicating most or all layers below) 10
- U. Unknown

Score

5

Documentation:

Identify type of impact or alteration:

It can form large monospecific stands along upper coastal habitats and mud flats and integrate into densely vegetated wetland sites in California (Bixby 2004).

Rational:

Sources of information:

Bixby, M. D. 2004. Wetland Vegetation at Shea Park. On-line document. Available: <http://www.bixby.org/parkside/multimedia/vegetation/> [January 12, 2005].

1.3. Impact on Natural Community Composition

- A. No perceived impact; causes no apparent change in native populations 0
- B. Influences community composition (e.g., reduces the number of individuals in one or more native species in the community) 3
- C. Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community) 7
- D. Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community) 10
- U. Unknown

Score

3

Documentation:

Identify type of impact or alteration:

This species appears to often establish in areas with few other plant species, but likely reduces the density and number of species present in upper coastal habitats (M. Shephard – pers. comm.).

Rational:

Sources of information:

Shephard, M. Vegetation Ecologist, USDA, Forest Service, Forest Health Protection, State and Private Forestry, 3301 C Street, Suite 202, Anchorage, Alaska 99503 Division. Tel: (907) 743-9454 - Pers. comm.

1.4. Impact on higher trophic levels (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades)

- A. Negligible perceived impact 0
- B. Minor alteration 3

- C. Moderate alteration (minor reduction in nesting/foraging sites, reduction in habitat connectivity, interference with native pollinators, injurious components such as spines, toxins) 7
- D. Severe alteration of higher trophic populations (extirpation or endangerment of an existing native species/population, or significant reduction in nesting or foraging sites) 10
- U. Unknown

Score

3

Documentation:

Identify type of impact or alteration:

Brassbuttons is pollinated by insects and may therefore alter pollinator's behavior (Plants for a future 2002, van der Toorn 1980).

Rational:

Sources of information:

Plants for a future. 2002. Species Database. *Cotula coronopifolia*. Available: http://www.ibiblio.org/pfaf/D_search.html [January 12, 2005].

van der Toorn, J. 1980. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. I. Geographic distribution, habitat, and field observation. *Acta Botanica Neerlandica*. 29(5/6): 385-396.

Total Possible

40

Total

14

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode of reproduction

- A. Not aggressive reproduction (few [0-10] seeds per plant and no vegetative reproduction) 0
- B. Somewhat aggressive (reproduces only by seeds (11-1,000/m²)) 1
- C. Moderately aggressive (reproduces vegetatively and/or by a moderate amount of seed, <1,000/m²) 2
- D. Highly aggressive reproduction (extensive vegetative spread and/or many seeded, >1,000/m²) 3
- U. Unknown

Score

3

Documentation:

Describe key reproductive characteristics (including seeds per plant):

Common brassbuttons propagate by seed and pieces of stem that root at the nodes (Plants for a future 2002). The number of seeds produced per plant can range from 13,300 to 50,200 (van der Toorn 1980).

Rational:

Sources of information:

Plants for a future. 2002. Species Database. *Cotula coronopifolia*. Available: http://www.ibiblio.org/pfaf/D_search.html [January 12, 2005].

van der Toorn, J. 1980. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. I. Geographic distribution, habitat, and field observation. *Acta Botanica Neerlandica*. 29(5/6): 385-396.

2.2. Innate potential for long-distance dispersal (bird dispersal, sticks to animal hair, buoyant fruits, wind-dispersal)

- A. Does not occur (no long-distance dispersal mechanisms) 0
- B. Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations) 2
- C. Numerous opportunities for long-distance dispersal (species has adaptations such as pappus, hooked fruit-coats, etc.) 3
- U. Unknown

Score

2

Documentation:

Identify dispersal mechanisms:

Seeds are dispersed by water. Dispersal distance was about 350-450 m per year in study of van der Toorn (1980). Seeds dispersal by birds is possible, but it rarely occurs (van der Toorn 1980).

Rational:

The viability of seeds passing through intestine of geese was high in study of van der Toorn and ten Hove (1982).

Sources of information:

van der Toorn, J. 1980. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. I. Geographic distribution, habitat, and field observation. Acta Botanica Neerlandica. 29(5/6): 385-396.

van der Toorn, J. and H.J. ten Hove. 1982. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. II. – Experiment on germination, seed longevity, and seedling survival. Acta Oecologica 3 (17): 409-418.

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sales, use as forage/revegetation, spread along highways, transport on boats, contamination, etc.)

- | | |
|---|---|
| A. Does not occur | 0 |
| B. Low (human dispersal is infrequent or inefficient) | 1 |
| C. Moderate (human dispersal occurs) | 2 |
| D. High (there are numerous opportunities for dispersal to new areas) | 3 |
| U. Unknown | |

Score

Documentation:

Identify dispersal mechanisms:

Movement by humans is not likely, because it has generally inaccessible areas (van der Toorn 1980). Common brassbuttons is occasionally grown in gardens (Plants for a future 2002).

Rational:

Sources of information:

Plants for a future. 2002. Species Database. *Cotula coronopifolia*. Available: http://www.ibiblio.org/pfaf/D_search.html [January 12, 2005].

van der Toorn, J. . 1980. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. I. Geographic distribution, habitat, and field observation. Acta Botanica Neerlandica. 29(5/6): 385-396.

2.4. Allelopathic

- | | |
|------------|---|
| A. No | 0 |
| B. Yes | 2 |
| U. Unknown | |

Score

Documentation:

Describe effect on adjacent plants:

Unknown

Rational:

Sources of information:

2.5. Competitive ability

- | | |
|---|---|
| A. Poor competitor for limiting factors | 0 |
| B. Moderately competitive for limiting factors | 1 |
| C. Highly competitive for limiting factors and/or nitrogen fixing ability | 3 |
| U. Unknown | |

Score

Documentation:

Evidence of competitive ability:

Common brassbutton is not a completely successful colonist. It can maintain itself

only in particular habitats (van der Toorn 1980, van der Toorn and ten Hove 1982).
Rational:
 Survival of seedlings is very low (van der Toorn and ten Hove 1982). Common brassbutton has been decline or locally extinct on some estuaries in Europe (Lid and Lid 1984, van der Toorn and Hove 1982).
Sources of information:
 Lid, J. and D. T. Lid. 1994. Flora of Norway. The Norske Samlaget, Oslo. Pp. 1014.
 van der Toorn, J. 1980. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. I. Geographic distribution, habitat, and field observation. Acta Botanica Neerlandica. 29(5/6): 385-396.
 van der Toorn, J. and H.J. ten Hove. 1982. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. II. – Experiment on germination, seed longevity, and seedling survival. Acta Oecologica 3 (17): 409-418.

2.6. Forms dense thickets, climbing or smothering growth habit, or otherwise taller than the surrounding vegetation

- A. No 0
- B. Forms dense thickets 1
- C. Has climbing or smothering growth habit, or otherwise taller than the surrounding vegetation 2
- U. Unknown

Score

Documentation:
 Describe grow form:
 Common brassbuttons does not form dense thickets.
Rational:

Sources of information:

2.7. Germination requirements

- A. Requires open soil and disturbance to germinate 0
- B. Can germinate in vegetated areas but in a narrow range or in special conditions 2
- C. Can germinate in existing vegetation in a wide range of conditions 3
- U. Unknown

Score

Documentation:
 Describe germination requirements:
 Common brassbuttons has been observed germinated and established in vegetated grassy area in California (Bixby 2004).
Rational:

Sources of information:
 Bixby, M. D. 2004. Wetland Vegetation at Shea Park. On-line document. Available: <http://www.bixby.org/parkside/multimedia/vegetation/> [January 12, 2005].

2.8. Other species in the genus invasive in Alaska or elsewhere

- A. No 0
- B. Yes 3
- U. Unknown

Score

Documentation:
Species:
Cotula australis (Sieber) Hook. f. is common weed in urban coastal areas in California, but is not listed as an invasive species (McClintock 1993, USDA 2002).
Sources of information:
 McClintock, E. 1993. *Cotula*. In Hickman, J. C. (ed.) The Jepson Manual: Higher Plants of California. pp. 354-355.
 USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5

2.9. Aquatic, wetland, or riparian species

- A. Not invasive in wetland communities 0
- B. Invasive in riparian communities 1
- C. Invasive in wetland communities 3
- U. Unknown

Score

3

Documentation:

Describe type of habitat:

The species widely distributed along the beaches, tidal flats, and estuaries of the world (Bixby 2004, Hultén 1968, McClintock 1993, Welsh 1974).

Rational:

Sources of information:

Bixby, M.D. 2004. Wetland Vegetation at Shea Park. On-line document. Available: <http://www.bixby.org/parkside/multimedia/vegetation/> [January 12, 2005].

Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 p.

McClintock, E. 1993. Cotula. In Hickman, J. C. (ed.) The Jepson Manual: Higher Plants of California. pp. 354-355.

Welsh, S.L. 1974. Anderson's flora of Alaska and adjacent parts of Canada. Brigham University Press. 724 pp.

Total Possible

23

Total

11

3. DISTRIBUTION

3.1. Is the species highly domesticated or a weed of agriculture

- A. No 0
- B. Is occasionally an agricultural pest 2
- C. Has been grown deliberately, bred, or is known as a significant agricultural pest 4
- U. Unknown

Score

0

Documentation:

Identify reason for selection, or evidence of weedy history:

Common brassbuttons is not an agricultural weed.

Rational:

Sources of information:

3.2. Known level of impact in natural areas

- A. Not known to cause impact in any other natural area 0
- B. Known to cause impacts in natural areas, but in dissimilar habitats and climate zones than exist in regions of Alaska 1
- C. Known to cause low impact in natural areas in similar habitats and climate zones to those present in Alaska 3
- D. Known to cause moderate impact in natural areas in similar habitat and climate zones 4
- E. Known to cause high impact in natural areas in similar habitat and climate zones 6
- U. Unknown

Score

1

Documentation:

Identify type of habitat and states or provinces where it occurs:

Common brassbuttons colonizes salt and freshwater marshes along the coast in California (Bixby 2004, McClintock 1993). It has been reported from river estuaries in

Britain (van der Toorn 1980), New Zealand, and Australia (Calder 1961, Congdon and McComb 1981, Evans 1953).

Sources of information:

Bixby, M. D. 2004. Wetland Vegetation at Shea Park. On-line document. Available: <http://www.bixby.org/parkside/multimedia/vegetation/> [January 12, 2005].

Calder, D.M. 1961. Plant ecology of subalpine shingle river-beds in Canterbury, New Zealand. *The Journal of Ecology*. 49(3): 581-594.

Congdon, R.A. and A.J. McComb. 1981. The vegetation of the blackwood river estuary, South-West Australia. *The Journal of Ecology*. 69(1): 1-16.

Evans, L.T. 1953. The ecology of the halophytic vegetation at Lake Ellesmere, New Zealand. *The Journal of Ecology*. 41(1): 106-122.

McClintock, E. 1993. *Cotula*. In Hickman, J. C. (ed.) *The Jepson Manual: Higher Plants of California*. pp. 354-355.

van der Toorn, J. 1980. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. I. Geographic distribution, habitat, and field observation. *Acta Botanica Neerlandica*. 29(5/6): 385-396.

3.3. Role of anthropogenic and natural disturbance in establishment

- A. Requires anthropogenic disturbances to establish 0
- B. May occasionally establish in undisturbed areas but can readily establish in areas with natural disturbances 3
- C. Can establish independent of any known natural or anthropogenic disturbances 5
- U. Unknown

Score

3

Documentation:

Identify type of disturbance:

Common brassbuttons inhabit bare, wet mud or areas grazed by geese in estuaries or along rivers. It also occurs on inland sites, mostly in anthropogenically disturbed areas (van der Toorn 1980).

Rational:

Sources of information:

van der Toorn, J. 1980. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. I. Geographic distribution, habitat, and field observation. *Acta Botanica Neerlandica* 29(5/6): 385-396.

3.4. Current global distribution

- A. Occurs in one or two continents or regions (e.g., Mediterranean region) 0
- B. Extends over three or more continents 3
- C. Extends over three or more continents, including successful introductions in arctic or subarctic regions 5
- U. Unknown

Score

3

Documentation:

Describe distribution:

Cotula coronopifolia probably originated from South Africa. It now occurs in all west coast states of the United States, in Europe, South America, New Zealand, Australia, and Tasmania (Hultén 1968, USDA 2002).

Rational:

Sources of information:

Hultén, E. 1968. *Flora of Alaska and Neighboring Territories*. Stanford University Press, Stanford, CA. 1008 p.

USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. *The PLANTS Database, Version 3.5* (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

3.5. Extent of the species U.S. range and/or occurrence of formal state or provincial listing

- A. 0-5% of the states 0

- B. 6-20% of the states 2
- C. 21-50%, and/or state listed as a problem weed (e.g., “Noxious,” or “Invasive”) in 1 state or Canadian province 4
- D. Greater than 50%, and/or identified as “Noxious” in 2 or more states or Canadian provinces 5
- U. Unknown

Score

2

Documentation:

Identify states invaded:

Common brassbuttons has been reported from Alaska, Arizona, California, Massachusetts, Nevada, Oregon, and Washington (USDA 2002).

Rational:

Sources of information:

USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5 (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Total Possible

25

Total

9

4. FEASIBILITY OF CONTROL

4.1. Seed banks

- A. Seeds remain viable in the soil for less than 3 years 0
- B. Seeds remain viable in the soil for between 3 and 5 years 2
- C. Seeds remain viable in the soil for 5 years and more 3
- U. Unknown

Score

2

Documentation:

Identify longevity of seed bank:

Seeds buried in soil and permanently submerged in water lost viability after 23 months (van der Toorn and ten Hove 1982).

Rational:

Sources of information:

van der Toorn, J. and H.J. ten Hove. 1982. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. II. – Experiment on germination, seed longevity, and seedling survival. *Acta Oecologica* 3 (17): 409-418.

4.2. Vegetative regeneration

- A. No resprouting following removal of aboveground growth 0
- B. Resprouting from ground-level meristems 1
- C. Resprouting from extensive underground system 2
- D. Any plant part is a viable propagule 3
- U. Unknown

Score

2

Documentation:

Describe vegetative response:

The species is documented as regenerating from pieces of stem (Plants for a future 2002).

Rational:

Sources of information:

Plants for a future. 2002. Species Database. *Cotula coronopifolia*. Available: http://www.ibiblio.org/pfaf/D_search.html [January 12, 2005].

4.3. Level of effort required

- A. Management is not required (e.g., species does not persist without repeated anthropogenic disturbance) 0
- B. Management is relatively easy and inexpensive; requires a minor investment in human and financial resources 2
- C. Management requires a major short-term investment of human and financial resources, or a moderate long-term investment 3
- D. Management requires a major, long-term investment of human and financial resources 4
- U. Unknown

Score

3

Documentation:

Identify types of control methods and time-term required:

Common brassbuttons can grow on very soft, deep mud, making infestations nearly inaccessible by foot or boat. No herbicides are selective enough to be used in wetlands without the potential for injuring native species.

Rational:

Sources of information:

Total Possible

10

Total

7

Total for 4 sections Possible

98

Total for 4 sections

41

References:

Bixby, M. D. 2004. Wetland Vegetation at Shea Park. On-line document. Available: <http://www.bixby.org/parkside/multimedia/vegetation/> [January 12, 2005].

Calder, D.M. 1961. Plant ecology of subalpine shingle river-beds in Canterbury, New Zealand. *The Journal of Ecology*. 49(3): 581-594.

CLIMEX for Windows, Version 1.1a. 1999. CISRO Publishing, Australia.

Congdon, R.A. and A.J. McComb. 1981. The vegetation of the blackwood river estuary, South-West Australia. *The Journal of Ecology*. 69(1): 1-16.

Evans, L.T. 1953. The ecology of the halophytic vegetation at Lake Ellesmere, New Zealand. *The Journal of Ecology*. 41(1): 106-122.

Griffiths, M. 1994. Index of garden plants. The Royal Horticultural Society, The Macmillan Press LTD: London and Basingstoke

Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, CA. 1008 pp.

Lid, J. and D. T. Lid. 1994. Flora of Norway. The Norske Samlaget, Oslo. Pp. 1014.

McClintock, E. 1993. *Cotula*. In Hickman, J. C. (ed.) *The Jepson Manual: Higher Plants of California*. pp. 354-355.

Plants for a future. 2002. Species Database. *Cotula coronopifolia*. Available: http://www.ibiblio.org/pfaf/D_search.html [January 12, 2005].

USDA (United States Department of Agriculture), NRCS (Natural Resource Conservation Service). 2002. The PLANTS Database, Version 3.5 (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

van der Toorn, J. 1980. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. I. Geographic distribution, habitat, and field observation. *Acta Botanica Neerlandica*. 29(5/6): 385-396.

van der Toorn, J. and H.J. ten Hove. 1982. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. II. – Experiment on germination, seed longevity, and seedling survival. *Acta Oecologica* 3 (17): 409-418.

Welsh, S. L. 1974. Anderson's flora of Alaska and adjacent parts of Canada. Brigham University Press. 724 pp.

